
WORKING PAPER SERIES

# Which Banks Choose Deposit Insurance? Evidence of Adverse Selection and Moral Hazard in a Voluntary Insurance System

David C. Wheelock
Subal C. Kumbhaker

Working Paper 1991-005B
http://research.stlouisfed.org/wp/1991/91-005.pdf

PUBLISHED: Journal of Money, Credit and Banking,
February 1995.

FEDERAL RESERVE BANK OF ST. LOUIS
Research Division
411 Locust Street
St. Louis, MO 63102

---

*Published 11/91*

# WHICH BANKS CHOOSE DEPOSIT INSURANCE? EVIDENCE OF ADVERSE SELECTION AND MORAL HAZARD IN A VOLUNTARY INSURANCE SYSTEM

## ABSTRACT

The sharp increase in depository institution failures in recent years has drawn attention to the moral hazard created by under-priced deposit insurance. To identify possible reforms, researchers have begun to consider alternative deposit insurance arrangements. This paper contributes to that literature by examining the deposit insurance system of Kansas, which operated from 1909 to 1929. The Kansas system had a number of regulations that were intended to limit risk-taking, and membership was made voluntary to assuage objections that insurance forces conservative banks to protect depositors of high-risk institutions. Using individual bank data, we test explicitly whether adverse selection and moral hazard characterized the Kansas system. We find that risk-prone banks were the most likely to join the system at its inception. And, using a simultaneous equation model, we find that both adverse selection and moral hazard behavior were present throughout the system's first ten years.

**KEYWORDS:** Bank deposits, bank failures, banking--U.S. history, banking--U.S. regulation, deposit insurance, adverse selection, moral hazard

**JEL CLASSIFICATION:** G21, G28, N22

David C. Wheelock
Research Officer
Federal Reserve Bank of St. Louis
411 Locust Street
St. Louis, MO 63102

Subal C. Kumbhaker
Associate Professor
Department of Economics
The University of Texas at Austin
Austin, TX 78712

We thank Lee Alston, Mark Flood and Alton Gilbert for comments and David Cowen for research assistance.

# WHICH BANKS CHOOSE DEPOSIT INSURANCE? EVIDENCE OF ADVERSE SELECTION AND MORAL HAZARD IN A VOLUNTARY INSURANCE SYSTEM

## I. Introduction

Many economists have identified federal deposit insurance as an important contributor to the large number of bank and savings and loan failures in recent years.[1] To the extent of insurance coverage, depositors have little or no incentive to demand risk premia on deposit interest rates, and therefore a bank's cost of funds does not increase proportionally with its insolvency risk. Deposit insurance subsidizes risk-taking, therefore, creating a "moral hazard" in that banks with insured deposits will find it optimal to assume more risk than they would otherwise.[2] In recent years increased competition and liability deregulation have both encouraged and enabled depository institutions to increase risk-taking, and the number of failures has risen dramatically.[3]

Federal deposit insurance was enacted in 1933 in response to the bank failures of the Great Depression. Deposit insurance was not, however, a new policy. During the 19th and early 20th centuries a number of states had experimented with their own insurance plans, and in the 1930s deposit insurance opponents pointed to the unsatisfactory performance of many of these plans as evidence that federal insurance

---

[1] See Kane (1985, 1989), Kaufman (1989, pp. 208-09), and O'Driscoll (1988), for example.

[2] If regulators can accurately monitor bank risk and charge risk-adjusted premiums, there would be no incentive for banks to assume more risk than they would in the absence of insurance. Several studies have proposed risk-adjusted premiums, e.g., General Accounting Office (1991), to date, however, premiums remain unrelated to failure risk.

[3] Although federal deposit insurance was enacted in 1933, risk-taking was contained and failures were not a problem as long as regulations limited competition and protected charter values, and interest rates remained relatively low and stable [Keeley (1990)].

could not work. The American Bankers Association (1933, 43), for example, argued:

> As a matter of unbiased history ... the guaranty of deposits plan proved fallacious and unworkable.... It has proved to be one of those plausible, but deceptive, human plans that, in actual application only serve to render worse the very evils they seek to cure.

More detached study of the state plans finds that some worked better than others. Calomiris (1989) concludes that the 19th century Indiana insurance system, for example, minimized moral hazard problems by introducing a form of coinsurance that gave banks the incentive and ability to monitor each other and enforce conservative behavior. The plans of other states, like the infamous New York Safety Fund, suffered extensively from moral hazard and from adverse selection, i.e., that risk-prone banks chose to join the insurance system while conservative banks stayed out, leaving depositors without credible insurance.[4]

A number of proposals have been offered to reform the present deposit insurance system, from increased regulation of bank activities to privatization of deposit insurance.[5] Calomiris (1989) has shown that the 19th and early 20th century state deposit insurance systems can provide considerable insight into the current crisis and suggest how deposit insurance might be reformed to minimize problems in the future. This paper presents new evidence on the incentive effects of deposit insurance by studying the insurance system of Kansas, which operated from 1909 to 1929. The Kansas system had a number of unique features that were intended to limit risk-taking, including voluntary membership. This aspect makes it possible to compare the behavior of insured and

---

[4] Cooke (1909), Robb (1921), Federal Deposit Insurance System (1956) and Golembe (1960) also compare the various state systems.

[5] O'Driscoll (1990) critiques a number of reform proposals.

non-insured banks. Such a comparison of banks today is impossible since virtually all banks are insured by the FDIC.[6] Kansas officials imposed other regulations on insured banks, and supervision was reputed to be relatively strong. We test explicitly for moral hazard and adverse selection effects in the Kansas system in order to gauge whether these measures achieved their goals, as well as to offer new insights into the performance of different deposit insurance arrangements.

## II. The Kansas Deposit Insurance System

Kansas was the second of eight states to adopt an insurance system in response to an increase in bank failures following the Panic of 1907.[7] Membership was made voluntary, however, in response to complaints that deposit insurance penalizes conservative banks by forcing them to insure depositors of banks that are more likely to fail. Kansas officials were well aware that deposit insurance would be most attractive to risk-prone institutions, and imposed a number of regulations to limit adverse selection. Banks were required to have been in business for at least one year and undergo a state inspection before being admitted to the insurance system. Insured banks were further required to maintain capital of at least 10 percent of total deposits and surplus and undivided profits of at least 10 percent of total capital.[8]

---

[6] Federal deposit insurance is mandatory for all Federal Reserve member banks, and optional for state-chartered non-member banks. At present, 99% of all commercial banks, holding 99.5% of deposits are insured (Kaufman 1989, p. 320).

[7] The eight states were Kansas, Mississippi, Nebraska, North Dakota, Oklahoma, South Dakota, Texas, and Washington.

[8] Total capital is the sum of the par value of the bank's stock, the paid-in surplus, and undivided profits.

To limit risk-taking by insured banks, the state imposed interest rate ceilings on insured deposits and set insurance premiums that were inversely related to a bank's capital to deposit ratio. Insurance premiums were initially set at 1/20th of 1% of a bank's insured deposits *less* capital and surplus. Because of the low assessment rate, however, the reward for holding extra capital was small relative to the cost of capital.[9] If necessary to maintain the solvency of the insurance fund, assessments could be increased to 1/5th of 1% of deposits. To guarantee assessment payment, banks were required to deposit $500 of cash or eligible bonds with the state treasurer for each $100,000 of insured deposits. Banks could withdraw from the insurance system with six months notice; they remained liable, however, for assessments needed to reimburse depositors of failed banks during that period.[10] Finally, the state bank commissioner had the authority to suspend insurance for any bank found in violation of state regulations.[11]

In its early years the deposit insurance system was popular with both bankers and depositors. From 1909 to 1920, the number of insured banks and the deposits in those banks grew faster than those of non-insured state and national banks. The participation rate among eligible banks peaked at 65.6% in 1923, and the percentage of the state's

---

[9] A bank with $100,000 of eligible deposits, for example, would be charged $45 per year if it had capital and surplus of $10,000, or $42.50 if it had $15,000 of capital and surplus.

[10] See Cooke (1909) for a complete list of membership requirements and a comparison with those of other states.

[11] The reports of the bank commissioner do not state whether the insurance of any banks was suspended, and so we have been unable to determine whether this threat was credible.

deposits held in insured banks reached a high of 43.8% in 1921 [Federal Deposit Insurance Corporation (1956, p. 68)].[12]

The popularity of the insurance system declined, however, after a collapse of farm output prices in mid-1920 brought increased loan defaults and bank failures. Members of the insurance system proved to be the most susceptible to failure. Between 1920 and 1926, the failure rate of insured banks was 4.6%, versus 2.3% for non-insured state banks and just 0.8% for national banks [American Bankers Association (1933, p. 34)]. After the failure in 1923 of the American State Bank of Wichita, the state's largest insured bank, threatened the solvency of the insurance fund, other banks began to withdraw from the system to avoid increased insurance premiums.[13] A state supreme court ruling in 1926 permitted banks to withdraw without liability for further assessments by simply forfeiting the securities they had deposited with the state as a guarantee of assessment payment. Many banks then dropped out and, although the fund was not officially closed until 1929, the insurance of bank deposits in Kansas effectively ended.

The high failure rate of insured Kansas banks during the early 1920s indicates that the regulations intended to limit risk-taking were not entirely effective. For a random sample of Kansas banks in 1920, Wheelock (1992) finds that insured banks maintained less adequate capital than non-insured banks.[14] Wheelock also finds indirect evidence

---

[12] National banks were prohibited from participating in the state insurance system by a 1908 ruling of the Comptroller of the Currency. Unincorporated banks, trust companies, and state chartered banks not meeting the other membership requirements were also ineligible.

[13] It is conceivable that the benefits of insurance also declined if depositors began to question the solvency of the system, and hence to demand risk premia on insured deposits.

[14] The sample consisted of 160 insured and 99 non-insured banks. The average capital/asset ratio of insured banks was .134 and that of non-

that insured banks held higher risk portfolios, in that after controlling for capital adequacy, insurance status remains useful for predicting failure.[15] It is unclear, however, whether the effect of deposit insurance was to cause banks to be more risk-taking or merely to sort risk-prone from conservative banks. In this paper we attempt to discern whether the greater risk-taking by insured banks was due to moral hazard, adverse selection, or both.

## III. Adverse Selection in the Kansas System

If deposit insurance premiums are not tied to failure risk, then risk-prone banks will gain the most from the inherent insurance subsidy; hence they should be more likely to join a voluntary insurance system than conservative banks. We test for self-selection in the Kansas system by attempting to predict the insurance status of a random sample of eligible banks in 1910 using balance sheet information about them in 1908, the year prior to the introduction of deposit insurance.[16] We employ a probit regression framework, in which the dependent variable is a dummy that takes the value 1 if the bank was insured in 1910 and 0 if not.

If risk-prone banks were more willing to pay the costs of membership in the insurance system, we expect that less well capitalized

---

insured banks .163. The difference is statistically significant at the .01 level.

[15] The closer a bank was to failure, the better insurance status is at distinguishing failing from non-failing banks. The behavior of insured Kansas banks thus appears to have been like that of the "zombie" S&Ls of the 1980s that were insolvent, but permitted by regulators to remain open [Kane (1989)]. This behavior is consistent with the model of Furlong and Keeley (1989), in which risk-taking is higher the lower is the capital/asset ratio.

[16] Our sample consists of approximately one-fourth of the Kansas banks that were eligible for insurance in 1910. The data comes from biennial reports of the Kansas Commissioner of Banking. Complete source information is in the appendix.

banks were more likely to join the insurance system than others. We employ two alternative financial ratios, total capital to assets (capital/assets) and surplus and undivided profits to loans and discounts (surplus/loans), to test this hypothesis.[17] We expect the coefficients on each to be negative, i.e., that banks with lower capital ratios had a greater likelihood of joining the insurance system.

Loans are generally the most risky assets that banks hold; moreover, the loan portfolios of the small unit banks of Kansas were likely not well diversified. Wheelock (1992) finds that the higher was a bank's loan to asset ratio, the more likely it was to fail within two years of the balance sheet date. Thus the coefficient on this variable (loans/assets) should be positive in our insurance status regressions, since banks with relatively high ratios appear to have been riskier than others, and so might have had a greater demand for insurance.

Conservative banks are likely to hold relatively large reserves with which to meet deposit withdrawals. Although cash and other reserve items have low (or no) explicit yields, a high reserve to deposit ratio better enables a bank to accommodate unexpected deposit outflows without resorting to high-priced borrowing. Thus, we expect that banks with relatively high reserve to deposit ratios (cash/deposits) would in general be less risk-taking, and so the coefficient on this variable should be negative.

We also include the deposits to assets (deposits/assets) ratio as an independent variable. Presumably insurance lowered the cost of deposits, and hence the more a bank relied on deposits as a source of

---

[17] White (1984) and Wheelock (1992) both find the surplus/loan ratio to be important for distinguishing failing from non-failing banks.

funds the greater its demand for insurance. Thus a positive coefficient on this variable might be expected. It is likely, however, that the banks relying most heavily on deposits in 1908 were conservative banks that could attract deposits at a relatively low price because of their safety. In the days before insurance, banks routinely advertised their strength and conservatism. Risky banks with weak balance sheets probably had to pay higher interest rates to attract deposits, and therefore might have relied less heavily on them as a source of funds. This suggests that the coefficient on the ratio of deposits to assets should in fact be negative.

In a study of national banks failing during the banking panic of 1930, White (1984) found that the higher a bank's ratio of U.S. Government bonds to assets, the lower was its failure probability. If large bond holdings reflected relatively conservative behavior, then in the insurance status regressions it seems reasonable to expect a negative coefficient on the bond to asset ratio (bonds/assets). There is no information, however, about the quality or type of bonds that Kansas banks held in 1908, and it is unlikely that U.S. Government bonds comprised a significant portion of their portfolios before World War I. In the absence of such information, it is impossible to predict the sign of this variable's coefficient with confidence.

Finally, we include the ratio of bills payable and other liabilities to assets (bills pay./assets) as a regressor. The principal source of funds for a bank are deposits. But a bank might rely on alternative sources of funds if it is unable to attract sufficient deposits to finance expansion or to remain liquid in the event of deposit withdrawals or loan defaults. Wheelock (1992) and White (1984)

find that heavy reliance on non-deposit sources for funds is a useful predictor of bank failure, suggesting that risk-prone banks were more likely to have high ratios. It is reasonable therefore to expect a positive coefficient on this variable in the insurance status model. Relatively few banks had significant bills payable or other liabilities in 1908, however, so we are unsure how important this variable is likely to be here.[18]

We include two additional variables to help explain insurance status: bank size, as measured by the log of total assets (ln Assets), and the number of years since the bank received its charter (Age). On average, insured banks tended to be larger than non-insured banks, and we are interested in whether size remains important after controlling for other bank characteristics. We include age to capture intangibles, such as goodwill or management quality, that might have affected a bank's decision to join the insurance system. For example, depositors might have felt more secure putting their money in a bank that had been in business for many years. Older banks might have had less demand for insurance because they already enjoyed a comparatively low cost of deposits. If true, then the coefficient on age should be negative: the longer a bank had been in business, the less likely it was to join the insurance system.

Model estimates are reported in Table 1. We find that the lower a bank's capital to asset ratio in 1908, the more likely it was to belong to the insurance system in 1910. This strongly suggests adverse selection: risk-prone banks were more likely to join than were

---

[18] Of 182 banks in the sample, 55 had outstanding bills payable or other liabilities, but in many cases the amounts were quite small.

conservative banks. The coefficient on an alternative measure of capital adequacy, the surplus to loan ratio, is not statistically significant. Equation 1.1 also indicates that the higher a bank's loan to asset ratio or bond to assets ratio, the more likely it was to join the insurance system. The sign and significance of the coefficient on the bond to asset ratio is consistent across specifications, but that on the loan to asset ratio is not.

We find that the higher a bank's deposit to asset ratio in 1908, the less likely it was to join the insurance system, suggesting that banks relying relatively heavily on deposits before the founding of the system did so because they were conservative and could attract deposits at comparatively low cost. The ratio of cash and other reserves to deposits does not appear of any value in predicting insurance status, however, nor does the ratio of bills payable and other liabilities to assets.

Equation 1.3 omits the bond to assets and bills payable to assets ratios.[19] The only substantive difference with this specification is the statistical significance of bank size: larger banks appear to have been somewhat more likely to join the insurance system. We also find that the more years a bank had been in business, the less likely it was to join the insurance system. Apparently, established banks gained less from joining the insurance system in terms of lower deposit costs than did newer banks.

---

[19] We report this specification since we are unable to predict the coefficient sign of the bonds/assets ratio, and because few banks had large amounts of bills payable outstanding in 1908.

## IV. Risk-Taking in the Mature System

It seems apparent that the first members of the Kansas deposit guaranty fund were riskier than those banks electing to not join the system. Did adverse selection continue to characterize the system over time? We have collected data for a panel of banks from 1910 to 1920, the years when the Kansas system was growing in terms of membership and percentage of the state's bank deposits. Our random sample consists of 212 eligible banks that operated continuously from 1910 to 1920.[20] We use these data to explore further whether the Kansas system suffered from the problems of adverse selection and moral hazard.[21]

Balance sheet comparison of insured and non-insured banks indicates that insured banks were less well capitalized. Table 2 reports comparisons of the mean capital/asset and surplus/loan ratios for insured and non-insured banks in each year of our sample. The mean ratios of insured banks were lower than those of non-insured banks in each year.[22] We have disaggregated these data further to compare the mean ratios of newly insured banks and insured banks that had also been

---

[20] Our data are for a random sample of one-fourth the eligible state banks in 1914. We collected data for each of these banks from the Kansas Commissioner of Banking reports for 1910, 1914, 1918, and 1920, which are the only years for which balance sheets were published. All of the banks in the sample operated in each year, but we eliminated 28 banks from the sample in 1910 because they did not meet the various requirements for membership in the insurance system. Since all of the banks remaining in the sample were in business before the insurance system began, it excludes any banks opened for the purpose of exploiting the insurance system, which means our results should understate the extent of adverse selection and moral hazard in the Kansas system.

[21] We use the term "moral hazard" to mean any risk-taking induced by deposit insurance, whether observable by the insurer or not, and our measures of risk, the capital/asset and surplus/loan ratios, obviously were observable on the reporting dates.

[22] For both ratios the differences between insured and non-insured banks are statistically significant (at the .05 level or higher) in 1910 and 1920. For 1914 and 1918, the difference in the capital/asset ratio is significant.

members in the previous reporting year.[23] In each year newly insured banks had higher capital ratios than other insured banks, but both had lower mean capital ratios than non-insured banks. Banks joining the insurance system thus appear to have been riskier than those staying out. That banks belonging to the system in the previous year had the lowest ratios could reflect risk-taking induced by membership, or simply that the highest risk banks were the first to join the system.

Further evidence of how insurance system membership affected bank behavior is presented in Table 3. Here we compare the mean year to year changes in the capital ratios for uninsured banks, newly insured banks, and other insured banks. Between 1910 and 1914 the mean capital/asset ratio of uninsured banks rose, as it did for those insured in both years. It fell, however, for banks acquiring insurance between 1910 and 1914. Furthermore, the mean surplus/loan ratio increased least for newly insured banks.[24] Between 1914 and 1918 the mean capital/asset ratio of each class declined. Interestingly, the decline was largest for non-insured banks. Moreover, newly insured banks were the only class to have an increase in the surplus/loan ratio. This was also true between 1918 and 1920. It is clear from Table 2 that insured banks, particularly those having been insured for some time, were less well capitalized than non-insured banks. Comparison of changes in capital ratios is less illuminating, however, indicating a relative increase in

---

[23] Only three banks in our sample left the insurance system before 1920, one between 1910 and 1914 and two between 1914 and 1918. We are unable to determine whether they withdrew voluntarily.

[24] The differences in the capital/asset change and the surplus/loan change between non-insured and newly insured banks are significant at the .10 and .01 levels, respectively. The differences between newly insured and other insured banks are not significant.

risk for newly insured banks between 1910 and 1914, but not for other years.

To further study whether the Kansas deposit insurance system caused increased risk-taking, or simply attracted banks that would have been riskier in any event, we estimate a two-equation model of the following type:

$$Y_1 = \alpha_1 Y_2^* + \beta_1' X_1 + u_1 \qquad (1)$$

$$Y_2^* = \alpha_2 Y_1 + \beta_2' X_2 + u_2, \qquad (2)$$

where $Y_1$ measures the riskiness of a bank and $Y_2^*$ measures its (unobserved) desire to belong to the deposit insurance system. We observe $Y_2$, which is a dichotomous variable defined as:

$Y_2 = 1$ if $Y_2^* > 0$

$Y_2 = 0$ otherwise.

In other words, a bank joins the insurance system only when its desire to do so exceeds a certain threshold (which we normalize to zero). If adverse selection is present then $\alpha_2$ will be positive. Similarly, if insurance system membership encourages risk-taking, then $\alpha_1$ will be positive. The X variables in (1) and (2) represent various regressors believed to affect bank riskiness and the desire to carry deposit insurance. They are discussed below.

The parameters of Equation (2) cannot be estimated consistently with maximum likelihood probit because $Y_1$ is endogenous and correlated with $u_2$. Similarly, the OLS estimates of (1) (replacing $Y_2^*$ with $Y_2$) may be inconsistent because $Y_2$ and $u_1$ may not be independent. Consistent estimates can, however, be obtained from the reduced form of (1) and (2), viz.,

$$Y_1 = \pi_1 X + v_1 \qquad (3)$$

$$Y_2^* = \pi_2 X + v_2. \qquad (4)$$

Our interest is in the structural parameters ($\alpha_1$, $\alpha_2$, $\beta_1$, and $\beta_2$), which can be recovered uniquely from $\pi_1$ and $\pi_2$ only if (1) and (2) are <u>exactly</u> identified.

To estimate the structural parameters consistently, we adopt the following two-stage procedure. Because $Y_2$ is observed as a dichotomous variable, $\pi_2/\sigma_2$ (where $\sigma^2_2 = \text{var}(v_2)$) can be estimated consistently only by applying maximum likelihood probit to Equation (4). Thus we rewrite (4) as:

$$Y_2^{**} = Y_2^*/\sigma_2 = (\pi_2/\sigma_2)X + v_2/\sigma_2 = \pi_2^* X + v_2^*. \qquad (4a)$$

The structural equations (1) and (2) are now written as:

$$Y_1 = \alpha_1\sigma_2 Y_2^{**} + \beta_1' X_1 + u_1 \qquad (5)$$

$$Y_2^{**} = (\alpha_2/\sigma_2)Y_1 + (\beta_2'/\sigma_2)X_2 + u_2/\sigma_2. \qquad (6)$$

In the first stage, consistent estimates of $\pi_1$ and $\pi_2^*$ are obtained using OLS and maximum likelihood probit to estimate (3) and (4a), respectively. These estimates are then used to form instruments for $Y_1$ and $Y_2^{**}$, viz., $\hat{Y}_1 = \hat{\pi}_1 X$ and $\hat{Y}_2^{**} = \hat{\pi}_2^* X$, respectively. In stage two, we apply OLS to Equation (5) after replacing $Y_2^{**}$ with $\hat{Y}_2^{**}$. Similarly, maximum likelihood probit is used to estimate (6) when $Y_1$ is replaced with $\hat{Y}_1$. The resulting estimates are consistent.[25]

We measure risk ($Y_1$) with the capital/asset ratio, and expect $(\alpha_2/\sigma_2)$ to be negative if adverse selection is present. $Y_2$ is a binary variable reflecting the insurance status of a bank, 1 if insured and 0 if not. The control variables, $X_1$ and $X_2$, are those we believe might

---

[25] Note that the estimated parameters are $(\alpha_1\sigma_2)$, $(\alpha_2/\sigma_2)$, $\beta_1$, and $(\beta_2/\sigma_2)$; $\sigma_2$ cannot be identified.

have affected a bank's risk-taking or its decision to join the deposit insurance system.

The results in Table 1 indicate that membership in the deposit insurance system was related negatively to age. We therefore include this variable (Age) in $X_2$.[26] It seems likely that competition influenced a bank's decision to join the insurance system, and this could explain why newer banks were more likely to join. Established banks might have been able to attract deposits at relatively low cost, and therefore had less demand for insurance.

We include two additional variables that capture other aspects of competition and thus which might have affected a bank's membership decision. For each bank we include the ratio of insured to total banks in the bank's county (DIratio). In order to compete successfully for deposits, a bank might have been more likely to join the insurance system if most of its competitors were also members, regardless of its own preferences for risk. Banks in counties with few members might have felt less competitive pressure to join themselves.

We also include the ratio of total banks to county population (Bankpop) as a regressor. Because branching was not permitted, rural counties with low population density typically had the highest numbers of banks per person. It has often been argued that rural banking markets were disrupted by a dramatic decline in transportation costs between 1910 and 1920, as rural roads were improved and many farmers

---

[26] Although insurance system membership was also related to bank size and various financial ratios we do not include these variables in $X_2$ since they are not exogenous, but jointly determined with insurance status.

acquired an automobile or truck for the first time.[27] Regions with the highest numbers of banks per capita were most affected, therefore, as previously isolated banks were suddenly thrown into competition with one another. Those banks might have been more likely to join the deposit insurance system in effort to compete successfully in the new environment.[28]

To explain a bank's risk-taking we again include bank age and competition, as measured by the number of banks divided by population. We also include measures of local economic conditions that might have caused bank capital/asset ratios to vary systematically across counties. Aside from competitive changes induced by transportation improvements, banks located in rural counties might have behaved differently than those in cities, and so we include the percent rural of county population (Rural). Similarly, the capital/asset ratios of banks located in counties with relatively rapid economic growth might have been different than those of banks in other counties. Among the variables we include to control for differences in economic conditions are the overall change in county population between 1910 and 1920 (ΔPop), the percentage change in county improved farm acreage from 1910 to 1920 (ΔImpacre), and the percentage change in farm land value per acre from 1910 to 1920 (ΔLandvalue).[29] We also include regional and

---

[27] See Alston, Grove and Wheelock (1991) and Wheelock (1992) for references and analysis of the consequences of this technological change on bank failures.

[28] Keeley (1990) concludes that increased competition in recent years has eroded bank charter values and increased risk-taking. This suggests that greater competition may have increased the demand for insurance, as well as the incentive to take on additional risk.

[29] Changes in improved acreage tended to be highest in western counties since most of eastern Kansas was already cultivated by 1910, while changes in land value per acre were greatest in eastern Kansas.

annual dummy variables in both the deposit insurance and capital/asset ratio regressions to control further for systematic variation across regions and time.[30]

Our structural equation estimates are presented in Table 4. The results indicate that the Kansas deposit insurance system suffered from both adverse selection and moral hazard effects. In Equation 4.1 the coefficient on the predicted values of deposit insurance membership ($\hat{DI}$) is negative and statistically significant, supporting the hypothesis that membership in the insurance system led banks to hold lower capital/asset ratios than non-participating banks. There is some evidence also that banks in rural counties and those located in counties with relatively large increases in land value had higher ratios.[31]

Equation 4.2 indicates that adverse selection also characterized the deposit insurance system between 1910 and 1920. The coefficient on $\hat{C/A}$ (the capital/asset ratio "predicted" in the first-stage) is negative and statistically significant, showing that risk-prone banks had a higher demand for deposit insurance than did conservative banks. The positive and significant coefficient on the ratio of insured to total banks (DIratio) indicates also that a bank was more likely to belong to the system if its closest competitors were also members.[32]

---

[30] A full description of our data and sources is presented in the appendix.

[31] Each regression was estimated with four regional dummies and four dummies marking the years from which the balance sheet data are drawn. None of the regional dummies has a significant coefficient; those on the dummies for 1910 and 1914 are positive and statistically significant, while that for 1918 is negative and marginally significant. The dummy for 1920 was omitted.

[32] Since DIratio is the ratio of insured to total banks in a county, in counties with few banks (three counties had but 1 bank) the membership decision of a single bank has a large influence on this variable. Thus by including this variable as a regressor, we bias the other regressor coefficients toward zero and against finding adverse selection.

## V. Conclusion

The Kansas deposit insurance system suffered from both adverse selection and moral hazard. Using balance sheet information from 1908, the year before the introduction of deposit insurance, we are able to distinguish banks that joined the system in its first year of operation from those which did not. The lower a bank's capital/asset or deposit/asset ratio in 1908, the more likely it was to be a member of the system two years later. Risk-prone banks thus appear to have had a greater demand for deposit insurance and were the first to join the system.

Adverse selection continued to characterize the deposit insurance system throughout its first decade. We estimate a simultaneous equation model in order to disentangle adverse selection from risk-taking induced by insurance system membership, and conclude that both effects were present: risk-prone banks had a greater demand for deposit insurance and were more likely to join the system, while insurance system membership appears to have led banks to become riskier.

The findings of the paper should not be surprising. Since risk-prone banks gain the most from deposit insurance, it makes sense that a voluntary deposit insurance system in which premiums are imperfectly tied to risk would attract the most risk-prone banks. Moreover, in order to avoid subsidizing other insured banks, an insured bank would have an incentive to increase risk. Our evidence shows that these incentives were not contained by regulations or supervision. Ultimately, the Kansas deposit insurance system collapsed, and depositors of failed banks were not reimbursed. The experience of Kansas, and other states having insurance systems, illustrates the

difficulty of designing a system that does not ultimately break down and shows that the experience of the 1980s was far from unique.

TABLE 1

Which Banks Choose Insurance? Probit Model Estimates
Dependent Variable: Insurance Status in 1910

| Variable | 1.1 | 1.2 | 1.3 |
|---|---|---|---|
| Capital/ Assets | -9.68 (2.25)*** | | -4.50 (1.65)* |
| Surplus/ Loans | | -0.85 (0.46) | |
| Bonds/ Assets | 11.76 (2.53)*** | 6.10 (1.64)* | |
| Loans/ Assets | 6.17 (1.90)** | -0.02 (0.01) | 0.97 (0.48) |
| Cash/ Deposits | 4.31 (1.74) | -0.31 (0.23) | 0.40 (0.26) |
| Deposits/ Assets | -9.08 (2.57)*** | -2.42 (1.57)* | -5.96 (2.74)*** |
| Bills Pay./ Assets | -4.86 (0.70) | 3.27 (0.57) | |
| Age | -0.03 (1.47)* | -0.01 (0.79) | -0.03 (1.62)* |
| ln Assets | 0.26 (1.28) | 0.14 (0.76) | 0.39 (2.30)** |
| Log Likelihood | -106.56 | -109.71 | -110.16 |
| Obs. | 182 | 182 | 182 |
| No. Insured | 60 | 60 | 60 |

Notes: t-statistics in parentheses; ***, **, * indicate statistically significant at the .01, .05, and .10 levels, respectively (one-tail tests).

TABLE 2

Capital Ratio Comparisons,
Insured and Non-Insured Banks within Years

1910

| DI10 | Capital/Assets | Surplus/Loans | Observations |
|---|---|---|---|
| 0 | .2081 | .0866 | 142 |
| 1 | .1882 | .0675 | 42 |

1914

| DI10 | DI14 | Capital/Assets | Surplus/Loans | Observations |
|---|---|---|---|---|
| 0/1[a] | 0 | .2232 | .1089 | 94 |
| 0/1 | 1 | .1978 | .0951 | 118 |
| 0 | 1 | .2020 | .0971 | 77 |
| 1 | 1 | .1901 | .0913 | 41 |

1918

| DI14 | DI18 | Capital/Assets | Surplus/Loans | Observations |
|---|---|---|---|---|
| 0/1[a] | 0 | .1424 | .1025 | 78 |
| 0/1 | 1 | .1238 | .0880 | 134 |
| 0 | 1 | .1354 | .0928 | 19 |
| 1 | 1 | .1219 | .0872 | 115 |

1920

| DI18 | DI20 | Capital/Assets | Surplus/Loans | Observations |
|---|---|---|---|---|
| 0 | 0 | .1496 | .0951 | 69 |
| 0/1 | 1 | .1314 | .0808 | 143 |
| 0 | 1 | .1434 | .0876 | 9 |
| 1 | 1 | .1306 | .0804 | 134 |

DI10 equals 0 for banks that were not insured in 1910 and equals 1 for those that were insured. DI14, DI18, and DI20 are defined similarly. An entry of 0/1 includes both insured and non-insured banks.

[a] One bank that was a member of the insurance system in 1910 was not in 1914, and two banks that were members in 1914 were not in 1918.

TABLE 3

Capital Ratio Comparisons Across Years

1910 to 1914[a]

| DI10 | DI14 | C/A14–C/A10 | S/L14–S/L10 | Observations |
|---|---|---|---|---|
| 0/1[b] | 0 | .0106 | .0307 | 75 |
| 0 | 1 | –.0035 | .0127 | 68 |
| 1 | 1 | .0010 | .0233 | 41 |

1914 to 1918

| DI14 | DI18 | C/A18–C/A14 | S/L18–S/L14 | Observations |
|---|---|---|---|---|
| 0/1[b] | 0 | –.0814 | –.0087 | 78 |
| 0 | 1 | –.0785 | .0036 | 19 |
| 1 | 1 | –.0763 | –.0080 | 115 |

1918 to 1920

| DI18 | DI20 | C/A20–C/A18 | S/L20–S/L18 | Observations |
|---|---|---|---|---|
| 0 | 0 | .0050 | –.0084 | 69 |
| 0 | 1 | .0189 | .0018 | 9 |
| 1 | 1 | .0067 | –.0083 | 134 |

C/A14–C/A10 and S/L14–S/L10 are the differences in the mean capital/asset and surplus/loan ratios between 1910 and 1914 for the category of banks indicated. C/A18–C/14 and S/L18–S/L14, and C/A20–C/18 and S/L20–S/L18 are defined similarly.

[a] These comparisons are for only those bank that were eligible for insurance in 1910.

[b] One bank that was an insurance system member in 1910 was not in 1914, and two banks that were insurance system members in 1914 were not in 1918.

TABLE 4

Tests for Moral Hazard and Adverse Selection
Second-Stage Estimates
Dependent Variables: Capital/Assets (Eq. 4.1),
Deposit Insurance Status (Eq. 4.2)

| Variable | 4.1[a] | 4.2 |
|---|---|---|
| Intercept | 10.05*** | 0.39 |
| | (7.02) | (0.42) |
| $\widehat{DI}$ | -0.78*** | |
| | (2.87) | |
| $\widehat{C/A}$ | | -14.00** |
| | | (2.16) |
| Age | -0.03 | 0.01 |
| | (0.91) | (1.07) |
| Bankpop | 0.15 | 0.27 |
| | (0.13) | (1.05) |
| Rural | 3.29*** | |
| | (2.74) | |
| ΔPop | 0.003 | |
| | (0.28) | |
| ΔImpacre | -0.003 | |
| | (0.18) | |
| ΔLandvalue | 0.03* | |
| | (1.93) | |
| DIratio | | 3.24*** |
| | | (9.70) |
| log like. | 1164.30 | -377.81 |
| obs. | 820 | 820 |

Notes: t-statistics are in parentheses; ***, **, and * indicate statistically significant at the .01, .05, and .10 levels (two-tail tests).

[a] the coefficients in this regression have been multiplied by 100.

Each regression also included regional dummies and dummies for each balance sheet year.

Variable definitions and data sources: see text and appendix.

## Appendix

Variable Definitions and Data Sources

All data for individual Kansas banks are from the Biennial Report of the Bank Commissioner (various years).

Age: the number of years between a bank's charter date and balance sheet date.

Bankpop: the number of state chartered banks in a county divided by county population. Sources: Biennial Report of the Bank Commissioner (number of banks), and 15th Census of the United States: Population, Vol. 1, Kansas Table 3 (1930, pp. 401-02).

DIratio: the ratio of insured to total state banks in a county. Source: Biennial Report of the Bank Commissioner.

ΔImpacre: the percentage change in county improved farm acreage, 1910 to 1920. Source: 14th Census of the United States: Agriculture, Vol. 6, part 1, Kansas Table 1 (1920, pp. 732-41).

ΔLandvalue: the percentage change in county farm land value per acre, 1910 to 1920. Source: 14th Census of the United States: Agriculture, Vol. 6, part 1, Kansas Table 1 (1920, pp. 732-41).

ΔPop: the percentage change in county population, 1910 to 1920. Source: 15th Census of the United States: Population, Vol. 1, Kansas Table 3 (1930, pp. 401-02).

Rural: the proportion of a counties population located on farms or towns of less than 2500 persons. Source: 14th Census of the United States: Population, Vol. 1, Table 50 (1920, p. 158).

## References


Alston, Lee J., Grove, Wayne A., and Wheelock, David C., "Why Do Banks Fail? New Evidence from the 1920s," working paper, 1991.

American Bankers Association. The Guaranty of Bank Deposits. New York, 1933.

Calomiris, Charles W. "Deposit Insurance: Lessons from the Record." Economic Perspectives, Federal Reserve Bank of Chicago, May/June 1989, 10-30.

Cooke, Thornton. "The Insurance of Bank Deposits in the West." Quarterly Journal of Economics, November 1909, 85-108.

Federal Deposit Insurance Corporation. Annual Report. Washington, D.C., 1956.

Furlong, Frederick T. and Keeley, Michael C. "Capital Regulation and Bank Risk-Taking: A Note." Journal of Banking and Finance, November 1989, 883-91.

General Accounting Office. Deposit Insurance: A Strategy for Reform, March 1991.

Golembe, Carter. "The Deposit Insurance Legislation of 1933: An Examination of its Antecedents and its Purposes." Political Science Quarterly, June 1960, 181-200.

Kane, Edward J. The Gathering Crisis in Federal Deposit Insurance, 1985.

____. The S&L Insurance Mess: How Did It Happen? Washington, D.C.: The Urban Institute Press, 1989.

Kansas. Biennial Report of the Bank Commissioner, various years.

Kaufman, George G. The U.S. Financial System. Englewood Cliffs, N.J.: Prentice Hall, 1989.

Keeley, Michael C. "Deposit Insurance, Risk, and Market Power in Banking." American Economic Review, December 1990, 1183-1200.

O'Driscoll, Gerald P. "Bank Failures: The Deposit Insurance Connection." Contemporary Policy Issues, April 1988, 1-12.

____. "Banking Reform." Research paper no. 9004, Federal Reserve Bank of Dallas, February 1990.

Robb, Thomas B. The Guaranty of Bank Deposits. Boston: Houghton Mifflin Co., 1921.

Wheelock, David C. "Deposit Insurance and Bank Failure: New Evidence from the 1920s," Economic Inquiry, forthcoming, 1992.

White, Eugene N. "A Reinterpretation of the Banking Crisis of 1930." Journal of Economic History, March 1984, 119-38.